CLAIMS

What is claimed is:

1. A biocompatible fluorescent silicon nanoparticle comprising a fluorescent silicon nanoparticle and a biocompatible coating.

2. The biocompatible nanoparticle of Claim 1, further comprising a biomolecule chemically linked to the biocompatible fluorescent silicon nanoparticle.

3. The biocompatible nanoparticle of Claim 1, wherein the fluorescent silicon nanoparticle has an absorption and emission maxima between about 300 nm and about 1,200 nm.

4. The biocompatible nanoparticle of Claim 1, wherein the size of the fluorescent silicon nanoparticle is about 0.5 nm to about 10 nm in diameter.

5. The biocompatible fluorescent silicon nanoparticle of Claim 1, wherein the biocompatible coating is a polymer.

6. The biocompatible fluorescent silicon nanoparticle of Claim 1, wherein the biocompatible coating is a silane.

7. The biocompatible fluorescent silicon nanoparticle of Claim 5, wherein the polymer is selected from the group consisting of carboxymethyl dextran, dextrans, polyethylene glycol, and biocompatible graft copolymers.

8. The biocompatible fluorescent silicon nanoparticle of Claim 5, wherein the polymer is selected from the group consisting of polyamino acids, polyethyleneamines, polysaccharides, polyamidoamines, polyacrylic acids, polyalcohols, polyoxyethylene sorbitan esters, polyoxyethytene and polyoxypropylene derivatives, polyoxyl stearates, polycaprolactones, polyanhydrides, polyalkylcyanoacrylates, polyglycerol surfactants, polycaprolactones, polyanhydrides, polymethylmethacrylate polymers, starch derivatives, dextran and derivatives thereof, fatty acids and derivatives thereof, polyethylene glycol, methoxypolyethylene glycol, methoxypolypropylene glycol, polyethylene glycol-diacid, and polyethylene glycol monoamine.

9. The biocompatible fluorescent silicon nanoparticle of Claim 2, wherein the biomolecule is selected from the group consisting of proteins, peptides, antibodies or antigen binding fragments thereof, cell receptor ligands, polysaccharides, cell receptors, enzyme substrates, enzyme cofactors, biotin, hormones, neurohormones, neurotransmitters, growth factors, cytokines, lymphokines, lectins, toxins, carbohydrates, membrane or transmembrane translocation signal sequences, and nuclear translocation signal sequences.

10. The biocompatible fluorescent silicon nanoparticle of Claim 1, wherein the biocompatible fluorescent silicon nanoparticle is a fluorescent silicon nanoparticle imaging probe.

11. The biocompatible fluorescent silicon nanoparticle of Claim 10, wherein the fluorescent silicon nanoparticle imaging probe is activated after target interaction.

12. The biocompatible fluorescent silicon nanoparticle of Claim 10, wherein the fluorescent silicon nanoparticle imaging probe has a high binding affinity to a target.

13. A method of *in vivo* optical imaging, the method comprising:
    (a) administering to a subject fluorescent silicon nanoparticle imaging probes of Claim 10;
    (b) allowing time for the fluorescent silicon nanoparticle imaging probes to contact a biological target;
    (c) illuminating the target with light of a wavelength absorbable by the fluorescent silicon nanoparticle imaging probes; and
    (d) detecting the optical signal emitted by the fluorescent silicon nanoparticle imaging probes.

14. The method of Claim 13, wherein steps (a) - (d) are repeated at predetermined intervals thereby allowing for evaluation of emitted signal of the fluorescent silicon nanoparticle imaging probes in the subject over time.

15. The method of Claim 13, wherein the signal emitted by the fluorescent silicon nanoparticle imaging probes is used to construct an image.

16. The method of Claim 15, wherein the image is co-registered with an image obtained by magnetic resonance or computed tomography imaging.

17. The method of Claim 13, wherein the subject is an animal.

18. The method of Claim 13, wherein the subject is a human.

19. The method of Claim 13, wherein the illuminating and detecting steps are done using an endoscope, catheter, tomographic system, hand-held optical imaging system, surgical goggles, or intraoperative microscope.

20. The method of Claim 13, wherein the presence, absence, or level of optical signal emitted by the fluorescent silicon nanoparticle imaging probes is indicative of a disease state.

21. The method of Claim 13, wherein the method is used in the early detection or staging of a disease.

22. The method of Claim 13, wherein the method is used in monitoring or determining a therapeutic course of action for a treatment of a disease.

23. The method of Claim 22, wherein the therapeutic course of action is surgical.

24. The method of Claim 22, wherein the therapeutic course of action comprises administration of a drug therapy.

25. The method of Claim 13, wherein the method is used to assess the effect of one or more drug therapies on a disease state.

26. The method of Claim 20, wherein the disease is selected from the group consisting of cancer, cardiovascular diseases, neurodegenerative diseases, immunologic diseases, autoimmune diseases, metabolic diseases, inherited diseases, infectious diseases, bone diseases, and environmental diseases.

27. The method of Claim 13, wherein in step (a), more than one distinguishable fluorescent silicon nanoparticle imaging probe is administered to the subject and wherein in step (d) more than one optical signal emitted by the fluorescent silicon nanoparticle imaging probe target is detected.

28. An *in vitro* optical imaging method, the method comprising:
(a) contacting a sample with the probes of Claim 10;
(b) allowing time for the probes to become activated or bind to the biological target of interest in the sample;
(c) optionally, removing the unbound probes;
(d) illuminating the target with light of a wavelength absorbable by the fluorescent silicon nanoparticle imaging probes; and
(e) detecting the optical signal emitted by the fluorescent silicon nanoparticle imaging probes.

29. The method of Claim 28, wherein the sample is selected from the group consisting of primary cells, cell cultures, tissue, and cytospin samples.

30. The method of Claim 28, wherein in step (a), more than one distinguishable imaging probe is administered to the sample and wherein in step (d) more than one target is detected simultaneously in a sample.